1-2.2 Writing Style. Use short and concise sentences. The U.S. Government Printing Office Style Manual provides general guidance for capitalization, punctuation, compounding of words, numerals in text, and spelling of nontechnical words. Use technical words only when no other wording will convey the intended meaning. Do not use quotation marks and underscoring for emphasis. Do not use words which have more than one meaning which will fit the context in which they are used, such as "replace" for "reinstall." Ensure nomenclature remains consistent within the publication and throughout parts lists, parts breakdowns, and other directly related publications. When identifying applicability for individual items of equipment use specific serial number(s), block designation(s), specific model designation(s), or similar identification. Technical publications published in accordance with this document shall make no reference to age, sex, race, or national origin. Use sex neutral terms but avoid use of the word "person." (Terms such as "midshipman" and "workman" are considered sex neutral.)

The second person imperative mood is used for procedures ("Remove test set from carrying case"). Third person indicative mood is used for descriptions and discussions ("When switch A is in the ON position, lamp 34 lights.")

Abbreviations and acronyms will be held to a minimum and each will be defined on its first appearance in each chapter. Abbreviations and acronyms will be in accordance with the requirements of MIL-STD-12. Where an equipment-unique abbreviation or acronym is identical to a MIL-STD-12 abbreviation or acronym, the equipment acronym takes precedence.

1-2.2.1 References. The text refers to:

a. Only models or types covered by the manual. To facilitate coverage of modified or additional models or types at a later date, references should be held to a minimum consistent with clarity.

b. Temperature readings as calibrated on the equipment. If other than Fahrenheit, give the equivalent parenthetically in Fahrenheit. Express general temperature references, such as room temperature, in degrees Fahrenheit.

c. Speed, distance, and meter readings as calibrated on the equipment. When the metric system is used on the equipment, follow parenthetically with U.S. conversion. If the technical content of the document so requires, convert U.S. measurements to metric measurements.

d. Switch positions and panel markings exactly as marked on the equipment.

e. Measurements in U.S. standard units (ounces, pounds, gallons, inches, feet, knots, miles, etc.) except instances in which metric measurements are required.

f. Illustrations by figure number, including section/letter/number when applicable, and the sheet number for multisheet illustrations. Refer only to illustrations within the same manual or in another volume of the same manual. Include figure and sheet number when referring to multisheet illustrations.

g. Index numbers on illustrations first, followed by the figure number (34, figure 2-67). However, when multiple references in a paragraph refer to the same figure, only the first reference need indicate the figure number.

h. Tables by table number. Refer only to tables within the same manual or in another volume of the same manual.

i. Other supporting paragraphs in the same manual or another volume of the same manual by paragraph number.

j. Other publication numbers (omitting dates, page, figure, and paragraph numbers) to avoid duplication of material. Refer only to publications in the publication system(s) of the service(s) that will use the publications and are authorized at user level.

1-2.2.2 Reference Placement. References will conform to the following.

a. When a reference applies to one item within a sentence, place the reference parenthetically immediately after the item being referenced. When a reference applies to an entire sentence, place the reference at the end of the sentence.

b. When the reference applies to an entire paragraph, place the reference after the paragraph head.

c. When reference is made to items in figures by reference designations, the numbers are indicated in the following manner: ON-OFF switch (1S8, figure 3-6).

1-2.3 Divisions of Manuals. Publications are divided into volumes, parts, chapters, sections, and paragraphs, as appropriate. There shall be at least two of each subdivision used. Where there is a volume 1 there shall be a volume 2; where there is a part 1 there shall be a part 2; where there is a chapter 1 there shall be a chapter 2, etc. All volumes, parts, chapters, sections, and numbered paragraphs are titled except procedural steps or those subparagraphs which follow a colon.

Two or more volumes are identified sequentially by volume numbers and subtitles indicative of volume content and have a unique Navy Technical Manual Identification Number System (TMINS) number assigned as provided by the procuring activity. Commercial manuals are identified by a number composed of the model number and manufacturer's federally assigned 5-digit Commercial and Government Entity (CAGE) identification number.

Volumes, parts, and chapters are numbered consecutively in Arabic numbers. Use upper case Roman numerals to number sections consecutively within each chapter. Each part is identified by both its volume and part numbers and has a unique TMINS number assigned as provided by the procuring activity.

1-2.3.1 Paragraphs. Text is divided into primary paragraphs and subordinate paragraphs. Subordinate paragraphs may be further identified as first subordinate, second subordinate, and third subordinate. There must be at least two numbered paragraphs per chapter or section. Paragraphs may also be divided into procedural steps. Procedural steps may be further divided if necessary. Decimal paragraph numbering and the order of heading is as follows:

1-1 PRIMARY SIDEHEAD.

1-1.1 First Subordinate Sidehead.

1-1.1.1 Second Subordinate Sidehead.

a. First procedural step.

(1) First subordinate procedural step

(a) First subsubordinate procedural step

1-2 NEXT PRIMARY SIDEHEAD.

1-2.1 Next Subordinate Sidehead

1-2.3.2 Procedural Steps. Procedural steps are used to provide step-by-step instructions, such as disassembly, reassembly, and alignment procedures. Steps may be further divided into substeps. Procedural steps and checklist items are numbered in accordance with subordination requirements. The steps/items are indented in block format.

The first line of procedural steps are indented two spaces or characters from the preceding paragraph. The first line of substeps are indented two additional spaces or characters. All lines of warnings, cautions, and notes are indented approximately five spaces or characters from both left and right margins. When the right margin is unjustified, indentations of five spaces are from the maximum allowable width of the typed text.

1-2.3.3 Page Numbers. Page numbers are located at the outer (loose-leaf) edge of the page. Even numbers, including zero, are assigned to left-hand pages and odd numbers to right-hand pages. To avoid rollover of pages when adding pages during a change, number the pages X-X.1, X-X.2, etc.

A blank page shall be assigned a number, but it shall appear on the preceding or following page; i.e., 1-9/(1-10

blank) or (1-9 blank)/1-10. Also, when applicable, an added page, such as 1-10.1 shall show that 1-10.2 is blank.

Pages, tables, and illustrations for chapters are numbered consecutively within each chapter using a two-part Arabic number separated by a hyphen. The first number is the chapter number and the second number indicates the order within the chapter. When a chapter starts with a full page illustration, the illustration may be placed on a left-hand page and the page numbered "zero," i.e., 2-0, 3-0, etc. Manuals divided into chapters and, in turn, into sections contain consecutively numbered pages, illustrations, and tables for the entire chapter. Multiple-sheet illustrations are consecutively sheet numbered following the title; i.e., (Sheet 1 of 3), (Sheet 2 of 3), etc.

1-2.3.4 Headings. Numbers and titles for parts, chapters, and sections are centered at the top of the first page of text for each. Parts and chapters begin on a right-hand page. The Section I heading is centered immediately below the chapter heading; subsequent section headings are centered on the page preceding applicable text.

1-2.3.5 Warnings, Cautions, and Notes. Warnings, cautions and notes (figure 1) must precede (on the same page) the text to which they apply. However, to prevent excessive gapping of text, a warning, caution, or note may end on an even numbered (left-hand) page of double-sided text. Warnings, cautions, and notes do not contain procedural steps. The headings are not numbered. When a warning, caution, or note consists of two or more paragraphs, the heading WARNING, CAUTION, NOTE, is not repeated above each paragraph. If it is necessary to precede a paragraph by both a warning and a note, or a caution and a note, etc., warnings shall precede cautions, which in turn shall precede notes. Warnings, cautions, and notes shall be short, concise, and used only to emphasize important or critical data. Normally no page should end with a warning, caution, or note.

WARNING: An operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in injury to or death of personnel.

CAUTION: An operating or maintenance procedure, practice, condition, statement, etc., which, if not strictly observed, could result in damage to or destruction of equipment or loss of mission effectiveness, or long-term health hazards to personnel.

NOTE: An essential operating or maintenance procedure condition, or statement, which must be highlighted.

Do not use notes in lieu of procedural steps. Notes are confined solely for use in narrative or illustrative nonprocedural data. Notes are never used in lieu of WARNINGS or CAUTIONS, nor are they used to modify an action.

1-2.3.6 Tables, Charts, and Graphs. Present reference data (other than illustrations, drawings, or diagrams) in tabular, chart, or graph form. Charts and graphs are considered illustrations, and are assigned figure numbers. When a small amount of tabulated information is to be inserted, and will not require referencing from adjacent text, it may be included within a paragraph of text without identifying it as a table.

A horizontal rule is placed at the beginning (head) and at the end (foot) of a table or chart. The table or chart number and title is centered above the head rule of a table or chart. The first letter of the first word and of each principal word is capitalized; the remaining letters are lowercase. The first letter of the first word of a boxhead title is capitalized; the remaining letters are lowercase. Tables are so designed that related entries in different columns are aligned. Carryover lines are to be indented two spaces.

When a table or chart is continued on a following page, the number and title are normally repeated at the head of the columns on all following pages of the table, followed by a dash and the abbreviation CONT. However, identification of continued material in a change package must follow the original format of the manual.

Tables may be vertically ruled as required for clarity. Horizontal rules are placed at the beginning and at the end of the table or chart. The "closing" rule is omitted at the foot of a continued table or chart; the "opening" rule is omitted at the head of the continuation thereof.

1-2.3.7 Illustrations. A manual may contain illustrations such as a frontispiece (assembled view), exploded, operational, procedural, functional, or location views. Artwork must clearly, adequately, and economically portray the information to be illustrated. Illustrative material is used to: describe an item or idea if this can be done more efficiently and effectively by graphic methods; clarify text; present phases difficult to describe by text alone; call attention to details; and furnish graphic identification of parts and tools. Multiple sheet, or sequence number illustrations, in addition to step-by-step operational type, may be used for depicting disassembly, reassembly, removal, and installation. Locate illustrations as near as possible to the point at which they are first referenced.

Illustrations are assigned figure titles. The title follows the figure number and is centered below the applicable illustration. The title shall be short and describe the contents or purpose of the illustration.

Illustrations shall be legible line drawings and must be of raster scanning quality. Blueprints or photographs are not acceptable. Line tracings of photographs are acceptable. Parallel lines on wiring and schematic diagrams must in no case be less than 1/16 inch apart when reduced to printed size. Callouts (in uppercase type no smaller than 8-point and no larger than 10-point) are used, when necessary, to identify significant features. Except in chapter 6 where callouts are in numerical disassembly sequence, all callouts must be descriptive or noun names. Leader lines may end close to the callout and object, or may touch the objects to which the lines apply. Lines must be uniform, as short and straight as possible. Lines must not cross or come in contact with other callout lines nor shall they obscure essential details. Arrowheads may be added for clarity.

Only the use of a pointing hand is acceptable for identifying new or changed items on illustrations.

Designations, diagrams, and graphic and letter symbols must comply with DOD-STD-100 or appropriate industry standards. New designations, diagrams, and symbols not covered by DOD-STD-100 or appropriate industry standards may be used so long as they are explained in the manual.

When an illustration will exceed one page, unless the usefulness of an illustration will be adversely affected, the illustration is divided and planned for presentation on facing pages and numbered: Figure 1-1 (Sheet 1 of 2) and Figure 1-1 (Sheet 2 of 2).

Foldout pages should be avoided if possible. If required, specifications on format for foldout pages will be provided by the contractor. Foldouts are placed at the end of the chapter.

1-2.4 Technical Content Arrangement.

The contents shall be arranged in chapters in accordance with the following:

a. Chapter 1 - General Information and Safety Precautions
b. Chapter 2 - Operation
c. Chapter 3 - Functional Description
d. Chapter 4 - Scheduled Maintenance
e. Chapter 5 - Troubleshooting
f. Chapter 6 - Corrective Maintenance
g. Chapter 7 - Parts Breakdown
h. Chapter 8 - Installation

1-2.4.1 Chapter 1 - General Information. This chapter contains an overall description of the functions and purposes of the equipment. This information is intended for use at the command level and for others requiring a general summary of the equipment or system, its performance, and limitations. This chapter will not include information on operation and maintenance. Figure 1 contains the standard wording for page 1-1 of each manual.

The next numbered paragraph is the introduction which provides an explanation of the purpose and scope of the technical manual.

The equipment description is non-technical and describes the intended use (why, where, when, how, and with what), capabilities, and limitations of the equipment. Text covering physical description or structural arrangement is brief, with special attention given to avoiding unnecessary or repetitious details that are easily illustrated. The equipment, or all units of the equipment, can be clearly illustrated and identified.

A pictorial illustration representing the equipment or all units comprising the equipment is included and designated Figure 1-1. The illustration shows the major units of the equipment, relative size of each unit, basic interconnections between units, and their relationship with other equipment.

Reference data is included in tabular form:

a. Descriptive (identification plate data) data which identifies manufacturer, type, model, component identification number (CID), and Repairable Identification Code (RIC), if available, as applicable.

b. Functional characteristics, such as: power requirements, horsepower, pressure, capacity, modes of operation, power output, frequency, pulse characteristics, sensitivity, selectivity, and tolerances, where applicable.

c. Capabilities and limitations, such as: pounds of thrust, knots, turning radius, minimum and maximum ranges, degree of coverage, resolution, accuracy.

d. Rated outputs, such as: wattages, voltages, horsepower, and gallons per minute.

e. Environmental characteristics, such as: ambient temperatures, heat dissipation per unit, humidity limits.

Equipments and systems (such as controls, accessory items, and related publications) which are not furnished with the basic equipment covered by this manual, but which attach or relate importantly to the basic equipment, are described in sufficient detail to establish their correlation with respect to physical and functional interfaces. If applicable, a reference should be made to the appropriate technical manual which contains additional information.

1-2.4.2 Chapter 2 - Operation. Operating instructions include routine and emergency procedures necessary to enable operating personnel to efficiently and effectively use the equipment in accomplishing its designated task. These operating instructions are in sufficient detail to allow operators not trained on the equipment, to independently and safely operate it with no special training.

The introduction describes each operator's relationship to the equipment and identifies those units having controls and indicators which the operator is expected to use in the performance of assigned duties. The introduction is supported by illustrations which identify and locate all operator controls and indicators. The intended function and application of the equipment is fully explained so that the operators will know exactly what they should expect to accomplish with the equipment.

1-2.4.2.1 Controls and Indicators. A description of all operator controls, indicators, protective devices, and jacks shall include the following:

a. Names of panel designations as marked on the equipment.

b. Positions and operating functions for each control and the normal operating condition of each indicator in each of the operating functions.

c?? When more than one operator is required to operate the equipment, their designated position, function, and relationship to the controls and indicators are specified.

CHAPTER 1

GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1 SAFETY PRECAUTIONS.

1-1.1 Warning/Caution Usage. The warnings and cautions appearing throughout this manual are of utmost importance to personnel and equipment safety. Thoroughly review and understand all warnings and cautions before making any attempt to operate, maintain, troubleshoot, or repair any part of the (insert name of equipment being covered here). Refer to the Safety Summary, found in the front matter pages of this manual, for a complete listing of warnings and cautions used throughout the manual.

1-1.2 Warning/Caution/Note Definitions. The following paragraphs define warnings, cautions, and notes as they are used in this manual.

WARNING

Warnings identify an operating or maintenance procedure, practice, condition, or statement which, if not strictly followed, could result in death or serious injury to personnel.

CAUTION

Cautions identify an operating or maintenance procedure, practice, condition, or statement which, if not strictly followed, could result in destruction of or damage to equipment or serious impairment of system operation.

NOTE

Notes highlight an operating or maintenance procedure, condition, or statement which is essential, but is not of known hazardous nature as indicated by warnings and cautions.

Figure 1. Chapter 1 Standard Wording

1-2.4.2.2 Operating Procedures. Operating procedures include the following:

a. Operator Turnon. All steps necessary to bring the equipment from off through standby condition to full operation.

b. Modes of Operation. Procedures for each mode of operation; e.g., manual, automatic, local, remote, etc. The use and relative advantage of each mode is described.

c. Operation Under Interfering Conditions. Describe the equipment antijamming and interference reduction features, the advantages of each feature, and the operating procedures to be followed in all possible situations. Supporting illustrations (such as indicator displays, waveforms, etc.) are included which provide typical observations of jamming and interference for evaluation by the operator.

d. Operator Turnoff. This procedure includes all steps necessary to bring the equipment from full operation through standby to the off condition.

e. Battle-short or Emergency Operation. This procedure covers operating the equipment during emergency conditions; e.g., control failure, air failure, lube oil failure, loss of cooling water, etc. Provide a warning or caution to return the equipment to proper operation when the emergency condition is corrected.

f. Emergency Turnoff. This procedure covers turning the equipment off during an emergency as in cases of fire, water, smoke, hazard to personnel, loss of coolant, normal power, etc.

1-2.4.2.3 Step-by-step Procedures. Operating procedures are concise, simply worded, instructions presented in tabular format and include the following:

a. A short explanation of the operation to be performed.

b. Initial safety requirements (actions, inspections, and emergency turnoff procedures).

c. Connection of any accessory equipment not permanently connected.

d. Instructions for obtaining or confirming the presence of all critical inputs such as power, coolant, air, signal, air-conditioning, etc.

e. Procedures for setting controls and making adjustments which must be accomplished by the operator before equipment turnon.

f. Procedures for determining operational readiness and the acceptable indications expected from built-in indicators such as meters, lamps, and gauges.

g. Milestones in the operational status of the equipment are identified and included by brief statements such as "The generator is now in STANDBY."

h. Visual or aural observations which occur as a result of an operator action, such as boom lowering, sweep rotation, blower motor running, etc.

i. Procedures that can be hazardous to personnel or equipment are emphasized by warnings or cautions placed immediately before the specific step involving the possible hazard. Do not use notes.

j. Illustrative material supporting the procedures identifies and locates all operating controls and indicating devices as well as normal in-use positions or indications.

k. Operator's checks and adjustments in proper sequence.

1-2.4.3 Chapter 3 - Functional Description. Chapter 3 includes a description of how the equipment operates. The description is in simplified technical language and supported by simple line illustrations, preferably on the same page. All illustrated assemblies, subassemblies, and components must be identified by noun names. A building block technique is used to functionally describe the operation of the equipment as follows:

a. Major subassemblies of the equipment are described and illustrated.

b. Interaction of major subassemblies are described and illustrated.

c. Detailed mechanical and electrical functional operation is described and illustrated.

d. A description of how the equipment works or operates is illustrated.

e. Overall and functional block diagrams and descriptions show the major functions of the equipment correlated in a logical manner to show outputs, inputs, cooling, built-in-test equipment, air pressurization, power distribution, etc. Hardware packaging is subordinated to the functional arrangement. The following shall apply:

(1) For multifunction equipments, whether single or multiunit, each major function is represented by a block and pressurization, power distribution, etc. All functions covered in Chapter 5 are shown on this diagram.

(2) The blocks are connected by lines and arrowheads showing the direction of the flow.

(3) Each block is identified by the functional name only.

(4) Each equipment input and output is identified by title. Waveforms are included as applicable.

(5) Modes of operation are identified by title or symbols, as applicable.

f. Functional descriptions of power distribution, power supplies, and regulators include the following:

(1) Briefly describe conventional electronic circuits and refer to the maintenance schematic diagrams in chapter 5. Describe alternating current (ac) and direct current (dc) power distribution in detail; support the descriptions by reference to the power distribution diagrams in chapter 5.

(2) Describe mechanical devices, cooling systems, etc.; that support the descriptions by reference to diagrams specified above.

1-2.4.4 Chapter 4 - Scheduled Maintenance.

Figure 2 contains the standard wording for chapter 4 in its entirety. If Planned Maintenance System (PMS) documentation does not exist for the equipment being covered by the technical manual, the contractor will provide guidance.

1-2.4.5 Chapter 5 - Troubleshooting. Troubleshooting procedures and data contain information necessary for a technician to locate common malfunctions in the equipment. This chapter contains instructions and information necessary to locate common troubles and conduct tests on each component, assembly, or subassembly of the equipment as follows:

a. Troubleshooting guides providing step-by-step procedures for logical isolation of faults. This information directs the technician to observe meters, fuses, circuit breakers, valves, and other available indicators which would indicate the presence of trouble.

b. Complete instructions on signal tracing for electric circuits including the use of special test instruments and unusual servicing techniques.

c. Where appropriate because of equipment complexity, troubleshooting diagrams including schematics giving details of mechanical and electrical assemblies and relationships.

1-2.4.5.1 Diagnostic Troubleshooting. This chapter also provides guidance regarding diagnostic analysis of possible trouble situations wherein malfunction, fault, or failure of the equipment or related equipment could render it inoperative or unable to perform its intended function. This information directs the operator/technician to observe lights, gauges, meters, fuses, circuit breakers, valves, and other available indicators which would indicate the presence of trouble. These instructions also cover tracing-out mechanical system flows and signals in electrical circuits, including the use of special test instruments and unusual servicing techniques. Kinds of troubles may include, but are not limited to, the following:

XXXXX-XX-XXX-XXX

CHAPTER 4

SCHEDULED MAINTENANCE

4-1 INTRODUCTION.

Scheduled maintenance instructions are furnished in the Planned Maintenance System (PMS). When conflicts exist between this manual and the PMS, the PMS documentation shall take precedence. Such conflicts should be reported immediately, in accordance with maintenance procedures, on one of the Technical Manual Deficiency/Evaluation Reports (TMDERs) found in the back of this manual.

4-2 PLANNED MAINTENANCE SYSTEM.

Recommended preventive maintenance procedures to be performed on a scheduled basis are provided in PMS documentation. OPNAVINST 4790.4 describes the PMS, and also covers departmental and work center record keeping, as well as the Maintenance Index Page (MIP) and Maintenance Requirement Cards (MRCs). The MRCs cover scheduled inspection and lubrication procedures for the (insert name of equipment being covered here). The extensive and comprehensive scheduled maintenance information provided by the MRCs precludes the need for detailed coverage within this chapter. Specific corrective maintenance requirements (adjustment, alignment, repair) are covered in chapter 6 of this manual.

Figure 2. Chapter 4 Standard Wording

a. Regulation of speed, load, voltage, current, temperature, fluid flow, or vacuum.

b. Excessive fluid leaks.

c. Inoperative valves.

d. Failure to start, operate, or stop equipment or accessories.

e. Failure of electrical circuit faults (open or closed circuits), circuit elements, readout equipment, or instrumentation.

f. Malfunction of safety devices.

g. Excessive vibration.

h. Bent or bowed rotating elements.

i. Damaged or broken gear teeth or mechanical or electrical interfaces.

1-2.4.5.2 Troubleshooting Charts. Troubleshooting guides in the form of charts are included to enable the technician to quickly identify (in the manual) the trouble or symptoms along with the immediate action to take, the probable cause, and the concurrent follow-on corrective action or remedy. Trouble analysis or troubleshooting charts should be included as tables in this chapter (see figure 3).

When diagrams included elsewhere in the manual are useful troubleshooting tools or aids, they are cross-referenced in the pertinent column of the applicable troubleshooting charts. As applicable, include simplified electrical schematics, piping diagrams, and mechanical schematic diagrams.

Table 5-1. Hydraulic Fluid System Troubleshooting

Malfunction	Probable Cause	Corrective Action
1. Neither hydraulic pump motor starts	Fluid level too low	Check sump tank fluid level and fill as necessary. If level is below 9 inches, fill to normal operating level.
	Temperature too high	Check fluid temperature at all thermometers. If temperature is greater than 120 °F (48 °C), refer to table 5-2, malfunction 1.
2. Both hydraulic pump motors shut down	Pressure too high	Check pressure at all pressure gauges. If pressure is greater than 1,750 psi, refer to malfunction 4.

Figure 3. Troubleshooting Table

1-2.4.6 Chapter 6 - Corrective Maintenance. This chapter contains instructions required to adjust and align the equipment; remove, repair, reinstall, and align all repairable parts, modules, subassemblies, and assemblies. The instructions identify the action to be accomplished; safety precautions to be observed; special tools, parts, materials, and test equipment required; preliminary control settings; test equipment setup instructions; and step-by-step instructions, with supporting illustrations, to accomplish the maintenance task. If more than three special tools or testing devices are required, present in tabular format, indicating name, part number, and use. Corrective maintenance instructions are provided to the manufacturer's designated lowest repairable level unless this information is included in another technical manual and can be referenced.

Use clear, sharp illustrations to supplement description and maintenance coverage, as required.

a. Typical bearings for rotating or moving equipment.

b. Method of taking clearance measurements where required.

c. Typical mechanism for absorbing thrust where applicable.

d. Locking devices when applicable.

e. Typical seal assembly (pressure and/or vacuum seals or controlled leakage between rotor and casing).

f. Typical assembly of blading to rotor, with lock devices, where applicable.

g. Typical assembly of field poles, laminated core iron, electrical windings, commutator, slip rings, and brush rigging where applicable.

h. Equipment assembly with upper-casing partially removed.

i. Series of illustrations showing installation of supervisory instruments (such as RTEs in bearings).

Include an introduction paragraph to explain the purpose, scope, and arrangement of the corrective maintenance data.

1-2.4.6.1 Section I, Adjustments and Alignment. This section contains all information and procedures required to perform all necessary adjustments and alignments as follows:

a. Operator/non-operator type adjustments.

b. Alignments requiring external jigs, test equipment, or bench setups.

c. Alignments that are accomplished after a repair or replacement of a part or module.

d. Test equipment setup and other illustrations necessary to support the procedures.

1-2.4.6.2 Section II. Repair. The repair section contains all procedures required in the repair of assemblies and repairable parts.

a. Removal, disassembly, and inspection.

b. Repair or replacement of piece parts.

c. Cleaning, reassembly, installation, calibration, and checkout.

d. Exploded view illustrations in top-down breakdown sequence to support the procedures.

e. Repair procedures are arranged in top-down breakdown numeric-alpha unit designation (disassembly) order of the equipment. (See figure 4.)

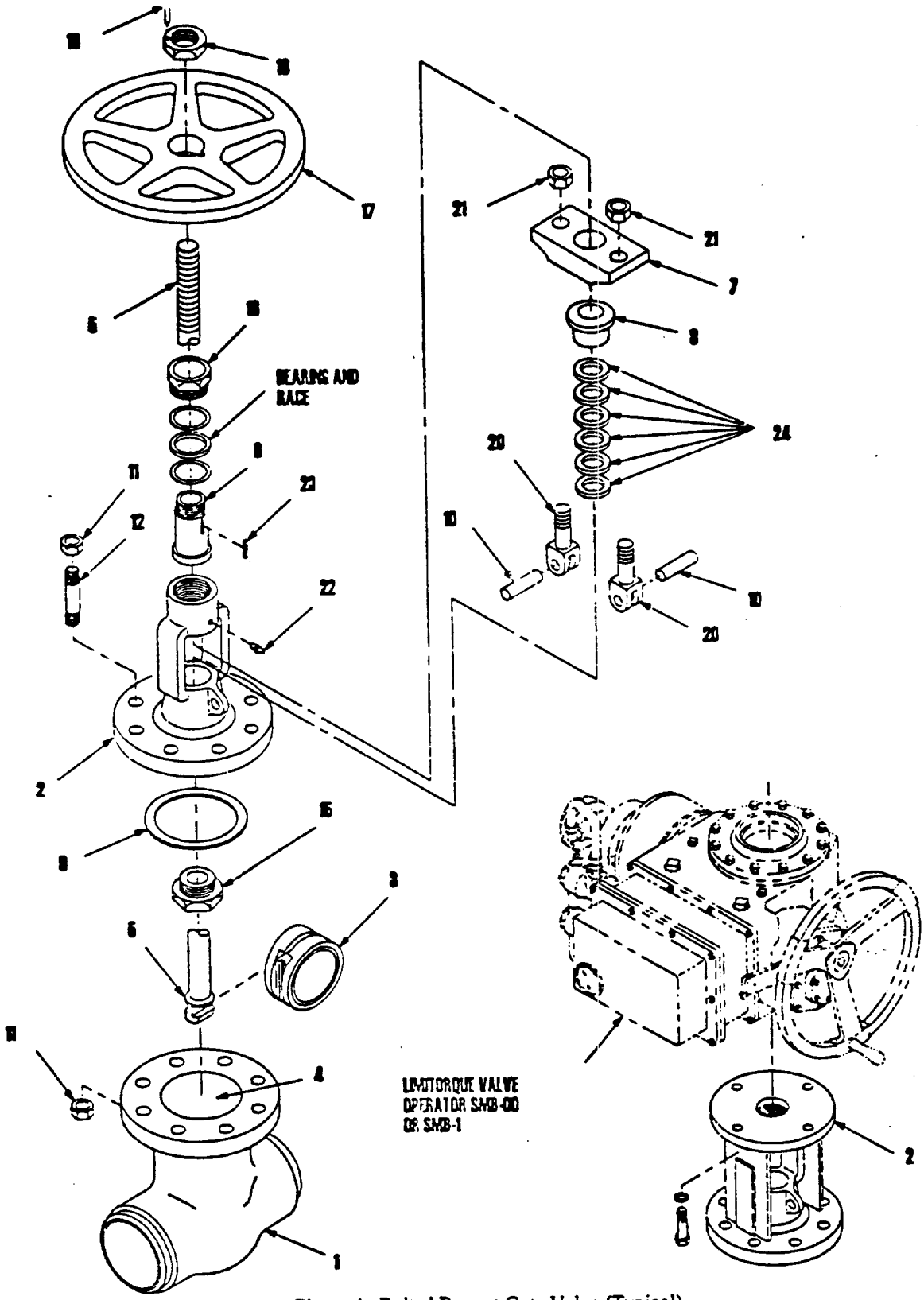

Figure 4. Bolted Bonnet Gate Valve (Typical)

1-2.4.7 Chapter 7 - Parts Breakdown. The parts breakdown (PB) contains the related parts lists for the equipment covered in this manual. The major equipment/installation and its related assemblies, subassemblies, and component parts and how they physically relate to each other is organized and broken down in disassembly sequence. The chapter's introduction contains the following information: explanation of the models, marks, and modifications; dash numbers; series; or blocks of the article covered by the breakdown. A definition of suitable used on code numbers appearing in the group assembly parts list (GAPL) when more than one variation of equipment is presented in this manual in tabular format. A tabular listing of the abbreviations and acronyms used in the GAPL is presented immediately following the last GAPL in this chapter.

1-2.4.7.1 Group Assembly Parts List. As shown in figure 5, each column of the GAPL contains the following information.

a. The figure and index number column lists in numerical order the figure and index number of each part shown on the corresponding illustration in chapter 6.

b. The reference designation column lists the manufacturer's established reference designation for each electrical, electronic, hydraulic, or pneumatic part shown on the corresponding illustration. If there are no such parts, the column remains blank.

c. The part number column lists the manufacturer or government part number for all parts shown on the corresponding illustration. Parts shown on the corresponding illustration that are generally available through a variety of commercial sources or vendors have the entry "COML" in this column. This column may also include the entry "NO NUMBER" indicating that the part has no applicable part number but is identified for procurement by the data in the description column. If the part has no applicable part number but is listed on a manufacturer's drawing parts list, the drawing number appears in this column followed by the entry "(DWG)."

d. The indent column contains a number to indicate relationship of the individual assemblies, subassemblies, and parts in the breakdown. The top assembly (first item) always has indent code "1." The indent codes increase in number to show the levels of subordination (of assemblies, to subassemblies, to parts). Normally, subordination is not needed beyond indent code "5." The indent sequence is as follows:

(1) An indent "1" indicates an installation, general arrangement, or primary assembly (first item listed). The first item (6-1-0, 6-2-0, etc.) in each GAPL always has indent number "1."

(2) An indent "2" indicates subassemblies or parts that are directly removable from, or associated with, the preceding indent "1" item.

(3) An indent "3" indicates additional subassemblies or parts that are directly removable from, or associated with, the preceding indent "2" item.

(4) The indent sequence continues in this manner to the lowest order/depth of disassembly.

e. The description column contains descriptions for all parts as illustrated in the applicable disassembly drawings. Wording is arranged so that the identifying noun or key word is always the first part of the description. If the item is an assembly or installation, the word "ASSY" or "INST" immediately follows the noun. This is followed by the balance of the modifying words included in the manufacturer's drawing title or parts list. When a separate illustration is used to show the detail parts of an assembly, the description column contains the appropriate figure cross-reference "(For Details See Fig. ___)." This forward cross-reference appears in the listing where the assembly is first described, and a backward cross-reference "(For NHA See Fig. ___)" appears in the listing in which the assembly is broken down. In this case, the abbreviation "REF" appears in the quantity per assembly column. The description column may also contain the entry "(AP)" which denotes that the item is an attaching part to the previously listed item having a figure and index number. Use of abbreviations and acronyms is highly desirable in the description column due to space constraints. Where an equipment-unique abbreviation or acronym is identical to a MIL-STD-12 abbreviation or acronym, the equipment acronym takes precedence and the MIL-STD-12 noun name is used in this column.

FIG.& INDEX NUMBER	REFERENCE DESIGNATION	PART NUMBER	INDENT	DESCRIPTION	MFR'S CODE	QTY PER ASSY	USED ON CODE
6-1-0		6371DM2139	1	DEVIATION FIELD METER AC MAGNETIC CONTROLLER	99999	003	
6-1-1	OX, OA, CR, UPX, DNX	6599CM558	2	CONTACTOR, AC CONT (FOR DETAILS SEE FIG. 6-17)	99999	005	
		COML	3	CAPSCREW, 3/8-11UNC-2B X 1-1/4-IN HEX		004	
6-17-0	OX, OA, CR, UPX, DNX	6599CM5583	1	AC CONTROL CONTACTOR (FOR NHA SEE FIG. 6-1)	99999	REF	
6-17-1		COML	2	NUT, 10-32UNF -		004	
6-17-2		COML	2	WASHER, NO 10		004	
6-17-3		COML	2	LOCKWASHER, NO 10 HICOL		004	
6-17-4		COML	2	SCREW, NO 10-32UNF-2A 7/16-IN PNH		004	
6-17-5		NO NUMBER	2	CASE, CONTACTOR	99999	002	

FIG.& INDEX NUMBER	REFERENCE DESIGNATION	PART NUMBER	INDENT	DESCRIPTION	MFR'S CODE	QTY PER ASSY	USED ON CODE
6-1-0		9X9XX9X	1	J-DIAL TELEPHONE	53711	AR	
6-1-1		9X9XX9X-	2	HANDSET (MIL-C- FOR DETAILS SEE FIG. 6-2)	53711	001	
6-1-2		COML	2	CORD, TEL HNDST (SPECIFY 4, 6, 8, 12, 20-FT LG, MIL-G-2212)		001	
		PL-125/8	3	PLUG, ELEC CL (MIL-G-2212)(AP)	9XX99	002	

Figure 5. Group Assembly Parts List

f. The manufacturer's code column lists a number identifying the manufacturer (supplier) of the part. The vendor's identification number is designated in H4/H8 Commercial and Government Entity publication. To provide a convenient reference for users of this manual and facilitate parts procurement as necessary, a list of manufacturers' names and addresses in CAGE code sequence is presented at the end of this chapter.

g. The quantity per assembly column contains one of the following entries: a number, indicating the quantity of the item at the indicated location only; the abbreviation REF, indicating that the required quantity is listed with the figure referenced as next higher assembly (NHA) in the description column; or the abbreviation AR, indicating that the item is used in quantity, size, or length as required.

h. The used on code column contains alphanumeric characters to indicate specific usability by serial, type, model, or series number on the articles for which the breakdown is prepared. If no code appears in this column, the item is applicable to all top assemblies/subassemblies listed in the GAPL.

1-2.4.7.2 Other Items. Do not list these items:

a. Parts which lose their identities by being welded or joined to other pieces as a permanent unit.

b. Items made from raw (bulk) stocks such as, lockwire, bonding braid, upholstery cloth, friction tape, etc.

c. Structural items such as, stringers, stiffeners, skin, doublers, gussets, etc., which serve no purpose in description of parts relationship or attachment of significant procured parts.

1-2.4.7.3 Items Requiring Special Attention.

a. Oversize and Undersize Parts. Oversize and undersize parts required and furnished, which are neither interchangeable with, nor within allowable production tolerances of, the standard size part, are identified as identified in the contract drawing specifications. Descriptive information is included which indicates all dimensional differences.

b. Tolerances for Electrical/Electronic Parts. Percentages or actual values of allowable tolerances for such items as nonmilitary standard resistors, capacitors, etc., are shown as a part of the description expressed as plus and minus values. Example: RESISTOR, Fixed, Cmpsn, 1000 Ohms, +5 Pct, -10 Pct, 1/2 W.

c. Undrilled or Untrimmed Parts. Design activity part numbers identified in the contract drawing specification requirements, are assigned to each part requiring drilling or trimming before installation. Notes are included in the description column to indicate that such parts require drilling or trimming at time of installation.

d. Matched Parts. Parts which would normally be individually procured, such as gears, cams, hydraulic sleeves and pistons, resistors, and vacuum tubes, but which have been machined to fit as a matched set or lapped assembly, or matched electronically to meet circuit requirements, are coded or annotated to indicate that the parts are not to be requisitioned separately because they are in a set and that the set of matched items or the next higher assembly must be requisitioned.

e. Quick Change Units. Items comprising a quick engine change assembly, or other quick change unit used as a maintenance spare to support the article, are identified by the symbol "QCU" located at the far right of the last line of the description column. Following the breakdown of the group or assembly to which the quick change unit relates, list in a straight-line format, all parts required to complete the unit, including those omitted pursuant to paragraph 1-2.4.7.2 as well as adapting parts, except when the quick change unit is to be repaired only at depot level, such as an electronic equipment module. In these cases, no parts listing is made. In all cases, the part number and description of the quick change kit, if applicable, follows the breakdown of the quick change unit.

f. Government Standard Items Containing Nonstandard Detail Parts. Items covered by Government standard drawings, including assembly drawings, are listed under the Government standard assembly part number except when the item contains repair parts which are not designated by Government detail design drawing numbers. In such cases, the item is identified by the design manufacturer's part number in the part number column and the Government standard part number, when known, is shown in the description column.

g. Government Standard Parts. Government standard parts are listed by the applicable MS, AN, AF, NAF, MIL, or JAN part number or specification number in the order of preference indicated in the contract

drawing specifications. Complete Government numbers, including prefixes and suffixes to the basic number, are shown in the part number column.

h. Altered, Selected, or Source-Controlled Government Standard, Vendor, and Commercial Items. When any Government standard, vendor, or commercial item is altered or selected or is a source-controlled item because of special fit, tolerance, weight, or reliability of performance, the part number of the design activity responsible for the alteration, selection, or source control appears in the part number column. Repainting, reidentifying, or other nonsignificant operations are not considered alterations, selections, or source controls.

i. Commercial Hardware. Commercial hardware procurable from normal commercial sources and not identifiable as Government standard is identified in the part number column by the manufacturer's part number. If a part number has not been assigned, the item is identified as commercial by the symbol "COML" in the part number column and identifying information such as dimensions, size, material, type, special features, and commercial catalog number is entered following the description. Such information must be sufficiently complete to enable the procuring activity to make replacement procurements from commercial sources.

1-2.4.7.4 Similar Assemblies. If right and left, top and bottom, front and rear, or other similar or symmetrically opposite assemblies contain a majority of identical parts, the assemblies are combined and broken down as follows:

a. Both assemblies are listed first, followed by the detail parts in disassembly order.

b. Parts peculiar to only one assembly shall have indicated, by code, footnote, or description, the assembly of which they form a detail.

c. Parts identical but differing in quantity per assembly are listed separately and are coded or explained by footnote or explained in the description column.

d. Parts identical and used in the same quantity are listed only once, and the units per assembly column shows the quantity required for one assembly only.

e. If a sufficient number of parts are not identical to both assemblies, or if the continuity of indention cannot be maintained by combining the listings, such assemblies are broken down separately.

1-2.4.7.5 Symmetrically Opposite Parts. Symmetrically opposite parts are identified in accordance with the contract drawing specifications. Symmetrically opposite parts are listed on separate lines.

1-2.4.7.6 Articles Without Part Numbers. Type and model numbers for equipment of Navy Commands such as, Naval Sea Systems Command, are not listed in the part number column. The phrase "NO NUMBER" is inserted in the part number column in these cases. The type and model designation are entered in the description column.

1-2.4.7.7 Vendor Items. When vendor items are listed, the vendor's part numbers are entered in the part number column. Vendor items are those used by the contractor exactly as produced by the vendor. The last sentence of 1-2.4.7.3.h regarding nonsignificant changes applies.

1-2.4.7.8 Redesigned Parts. When the design or the material of a part is changed to the extent that interchangeability or physical or functional performance is affected, the new part number assigned in accordance with the contract drawing specification is listed. The original part is omitted when not authorized for continued use. If the original part has continued application, the applicable model, block numbers, and serial number of the items on which the part is usable are indicated by the usable on code system. Such notes as "alternate for" or "use until exhausted" should follow the description as applicable.

1-2.4.7.9 Parts Kits. When repair parts for the article or for repairable units within the article are to be supplied in the form of kits, a part number is assigned to each kit in accordance with the contract drawing specification requirements. An appropriate notation is inserted in the description column, following the description of the article or unit for which the kit is supplied, of the fact that parts kit(s) are available.

1-2.4.7.10 Dimensions. When units of measurement are the same, they are not repeated with each dimension. Example: "1/8 X 21/32-inch". To avoid confusion, a hyphen is used between a whole number and a fraction. Example: "1-1/8 , 2-3/32, 4-9/64". When a decimal with a value of less than 1.0 is given, a zero precedes the decimal point.

1-2.4.7.11 Attaching Parts. Attaching parts are assigned index numbers consistent with index numbers assigned in the breakdown and are exploded only when the assembly procedure is hidden and sufficiently complex to merit explosion. If the attaching parts are not visible in the illustration (for example, the nuts attaching a transformer will not be visible on a chassis top view), a consolidated callout (one index number assigned to an attaching parts group, such as nut, bolt, washer) may be used with the leader line terminating on the visible attaching part.

1-2.4.8 Chapter 8 - Installation. Drawings and information concerning installation are provided in this chapter. Include the following types of information: site selection, or installation location guide lines (such as moisture precautions and maximum temperature allowed as appropriate), special tools and materials requirements, unpacking and handling (if unusual procedures or precautions are required), preparation of foundations, mechanical assembly procedures, mounting instructions, bolting diagrams, safety precautions, grounding and bonding, clearances for access, ventilation, fluid-cooling requirements, clearances for motion under shock, and recommendations for reduction of electrical and electromagnetic interference, and other interface requirements, as applicable. In addition, provide coverage for tests and test procedures required to demonstrate the equipment after installation is capable of satisfying operational requirements.

1-2.4.8.1 Installation Drawings. Installation drawings provided in digital format, Selected Record Drawings, etc., which are available to operator/maintenance personnel are listed for use in completing equipment installations and consist of the following:

a. Drawing list.

b. Block diagram.

c. Outline and installation drawing.

(1) Ensure the crated (if available) and uncrated height, width, and depth in inches (or inches and centimeters) of each unit or accessory is provided.

(2) Ensure the crated (if available) and uncrated weight and volume in cubic feet of each unit or accessory is provided.

d. Auxiliary cooling diagram.

e. Auxiliary dry-gas diagram.

f. Cable-running sheets.

g. Summary list of installation material.

h. RF transmission line diagram.

i. Hydraulic fluid piping diagram.

1-2.4.8.2 Site or Installation Location Information. Include data supplemental to the installation drawings. If all site information is contained on the installation drawings, reference the applicable drawing(s) by figure number.

1-2.4.8.3 Unpacking and Repacking. Include information supplemental to the installation drawings regarding unpacking and repacking. Include step-by-step procedures to prevent damage to the equipment or injury to personnel. Provide supporting illustrations to clarify procedures. When packing for reshipment is required, include step-by-step procedures for packing. When packing is simply the reverse of unpacking, this fact need only be stated. Provide any special environmental conditions required for storage. Include instructions for items in the following categories:

a. Depreservation procedures required at time of installation.

b. Represervation packaging required prior to repacking for storage or shipment.

c. Intricate mounting, blocking, or bracing.

d. Special cushion inserts.

e. Repairable items.

f. Sensitive or fragile components.

g. Items held in special cradles.

h. Items furnished in reusable containers.

i. Special environmental conditions required for storage.

j. Special handling procedures required.

k. Container storage or disposition instructions, as applicable.

Provide instructions sufficiently detailed to prevent handling damage to the equipment or injury to personnel. In addition, step-by-step procedural illustrations may be used to supplement the packing and handling instructions.

1-2.4.8.4 Installation Procedures. Provide supplemental information, which is not provided on the installation drawings, as follows:

a. Instructions required to assemble units.

b. Instructions required to mount units. Include bolting and bracing diagrams and data on shock mounts.

c. Instructions for making electrical, plumbing, transmission line, and all other external interface connections to the equipment.

d. Instructions for interconnecting units comprising the equipment.

e. Servicing procedures, such as initial lubrication.

f. Instructions for bonding and grounding.

Provide the necessary instructions to allow personnel to ensure that the equipment has been properly installed in all respects and is ready for operation. Include step-by-step procedures to initially energize, test, operate, and secure the equipment in all operational modes. If the operating procedures in chapter 2 provide the required information, they may be referenced rather than repeated.

1-3 MANUALS CONTAINING NAVAL NUCLEAR PROPULSION INFORMATION (NNPI) AND CLASSIFIED MATERIAL.

The contractor will develop NNPI and classified material manuals in accordance with applicable security regulations.

1-4 PACKAGING AND DELIVERY.

Electronic media deliverables are to be packaged in accordance with accepted industries standards for safety and security. The package will be distinctly marked to preclude the use or proximity of X-ray and/or magnetic equipment which could destroy the imprinted materials.

PROCEDURES, TEST

A. Subtitle: Non-Nuclear Test Program

1. Provide an integrated test listing which contains the following:

a. A test number containing the SWLIN number of the system involved and a sequence number. The Contractor will provide the ship with a description of the Contractor's test numbering system.

b. A description of the test (title).